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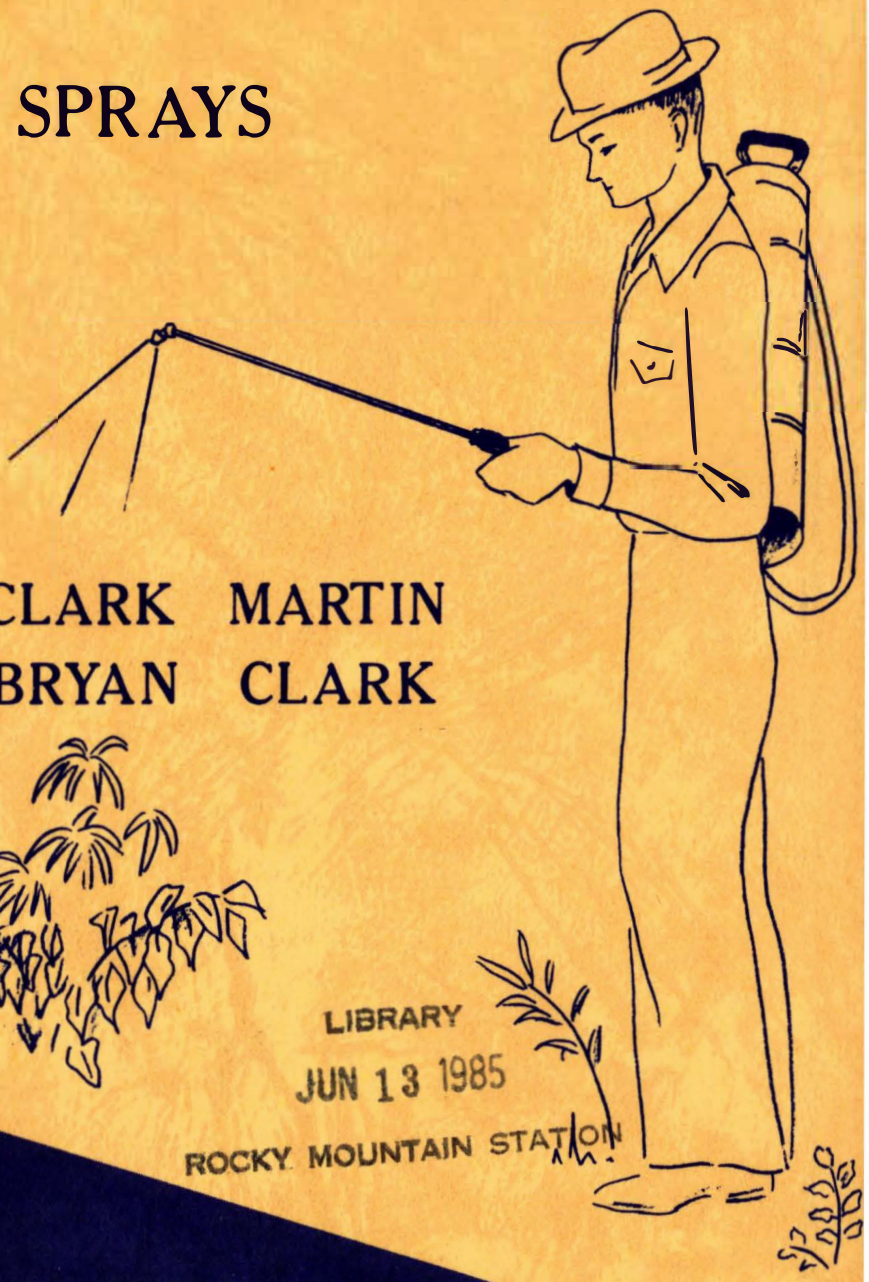
CONTROLLING HARDWOOD SPROUTS WITH FOLIAGE SPRAYS



S. CLARK MARTIN
F. BRYAN CLARK

CENTRAL STATES
FOREST EXPERIMENT STATION

COLUMBUS, OHIO

W. G. McGINNIES, DIRECTOR

UNITED STATES DEPARTMENT OF AGRICULTURE — FOREST SERVICE

This report is from the
Division of Forest Management
CENTRAL STATES FOREST EXPERIMENT STATION

Arthur G. Chapman, Chief

Columbia (Missouri) Forest Research Center
(Maintained in cooperation with the
University of Missouri
Agricultural Experiment Station)

Franklin G. Liming, Forester-in-Charge

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The Dow Chemical Company	Midland, Michigan
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M F A Oil Company	Columbia, Missouri

CONTROLLING HARDWOOD SPROUTS WITH FOLIAGE SPRAYS

S. CLARK MARTIN, Range Conservationist

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Controlling unwanted hardwood reproduction is difficult on forest and rangeland in the Missouri Ozarks. In the past, Ozark farmers have chopped, girdled, burned, grubbed, and goated in attempting to get rid of hardwood sprouts. These methods are seldom successful and usually cause accelerated erosion. The farmer needs a more effective, less destructive way to do this job.

Several promising new weed-killing chemicals are being tested on the Sinkin Experimental Forest in south-central Missouri. Results of a study begun in June 1950 to test the effectiveness of foliage sprays of ammate, 2,4-D, and 2,4,5-T for controlling hardwood seedlings and sprouts are reported here.

The study was made on a relatively level, dry Ozark ridgetop. Past cutting and repeated burning have left a dense stand of hardwood sprouts plus a scattered overstory of larger trees. The overstory trees average about 60 square feet of basal area per acre; most of them are less than 10 inches d.b.h. Post oak (Quercus stellata Wangenh.), black oak (Q. velutina Lam.), and blackjack oak (Q. marilandica Muenchh.) are the more abundant overstory species. Overstory trees were not treated.

The understory consists of about 3,500 clumps of hardwood sprouts per acre (fig. 1). The most numerous species are blackjack oak, post oak, black oak, white oak, (Q. alba L.), and hickory (Carya Nutt. spp.). Most of the sprout clumps developed after tree reproduction was killed back to the ground line by fire in 1944. Since the tops have been killed back several times by fire, the root systems are relatively large and much older than the tops. At the beginning of the study the sprout clumps averaged 5 to 6 years in age, 2.4 feet in height, and 3.1 feet in crown diameter.

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Figure 1.--
Typical sprout clumps before spraying.

Water solutions of six herbicides were sprayed on the foliage of a total of more than 3,000 sprout clumps. The herbicides used were:

ammate (ammonium sulfamate)
2,4-D-BE (butyl esters)
2,4,5-T-IE (isopropyl esters)
2,4,5-T-PE (propylene glycol butyl ether esters)
2,4,5-T-AM (amine)
2,4-D - 2,4,5-T-PE (50-50 mixture of propylene glycol butyl ether esters)

Three concentrations were used for each type of herbicide: for ammate, 1, 2, and 4 pounds per gallon of water; for the 2,4-D and 2,4,5-T compounds, 1.7, 4.2, and 8.3 pounds of acid per 100 gallons of spray solution.

Sample units in the study were made up of one or more rod-square plots. Each sample unit included enough plots to contain at least 20 blackjack oak clumps and 10 to 15 post oak clumps. Other species were taken as they occurred. Each of the 18 combinations of 6 herbicides and 3 concentrations was applied to 3 sample units. One of the 3 sample units was treated in the early morning, the second near mid-day, and the third in the later afternoon.

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Figure 2.-- Sprout clumps 2 years after spraying with high concentration of ammate.

A 3-gallon compressed-air, hand sprayer was used to apply the herbicides. The average tank pressure during application was about 30 pounds per square inch. The nozzle tips used produced a flat, 40-degree, fan-type spray. Large shields were placed along plot boundaries to minimize spray drift. Each sprout clump was sprayed until all exposed surfaces of leaves and stems were dripping wet. This rate of application was equivalent to about 50 gallons of solution per acre.

Data on the condition of each sprout clump were taken before treatment in June 1950 and in the fall of 1950, 1951, and 1952 and in mid-June 1953. A clump was listed as "dead" if it had no visible living leaves or stems. In addition total heights and crown areas of the live portions of sprout clumps were measured. The results for blackjack oak and post oak were so similar that data for the two species were combined. Except for species mortality, all results presented are for blackjack and post oak combined.

Ammate was Most Effective Herbicide

Mortality for blackjack oak and post oak ranged from 5 percent to 53 percent by June 1953 (table 1). Ammate was the most effective herbicide (fig. 2); averaging all three concentrations, it killed 39 percent of the blackjack and post oak sprouts. The 2,4,5-T-IE and 2,4-D-BE compounds were least effective. The other

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three chemicals were only a little more than half as effective as ammate. Differences in mortality by June 1953 between ammate and all other chemicals were significant at the 1 percent level.[1/] Likewise, mortality for sprouts sprayed with 2,4,5-T-AM, 2,4,5-T-PE, and 2,4-D - 2,4,5-T-PE was significantly greater than the mortality for sprouts sprayed with 2,4,5-T-IE.

Table 1.--Average mortality 3 years after treatment for blackjack oak and post oak for each herbicide and concentration

(In percent)

Herbicide	Concentration			
	Low	Medium	High	Average
Ammate	28	35	53	39
2,4-D-BE	16	14	8	13
2,4,5-T-IE	5	9	9	8
2,4,5-T-PE	21	23	18	21
2,4,5-T-AM	12	25	23	20
2,4-D - 2,4,5-T-PE	11	15	35	20
All chemicals	16	20	25	20

Sprout mortality probably is the best measure of the long-time effectiveness of chemical sprout-control methods. However, it is not always easy to determine because apparent mortality may change greatly from one observation to the next (fig. 3). For example, 3 months after treatment, the average mortality for all blackjack oak and post oak was only 1.5 percent. Comparable mortality percentages in 1951, 1952, and 1953 were 14, 19, and 20, respectively, showing that the greatest increase in mortality occurred between the first and second observations and the smallest increase between the third and fourth observations. The 1952 observation was the first to give a reliable mortality estimate. In other words, the first good estimate of mortality was made more than 2 years after treatment.

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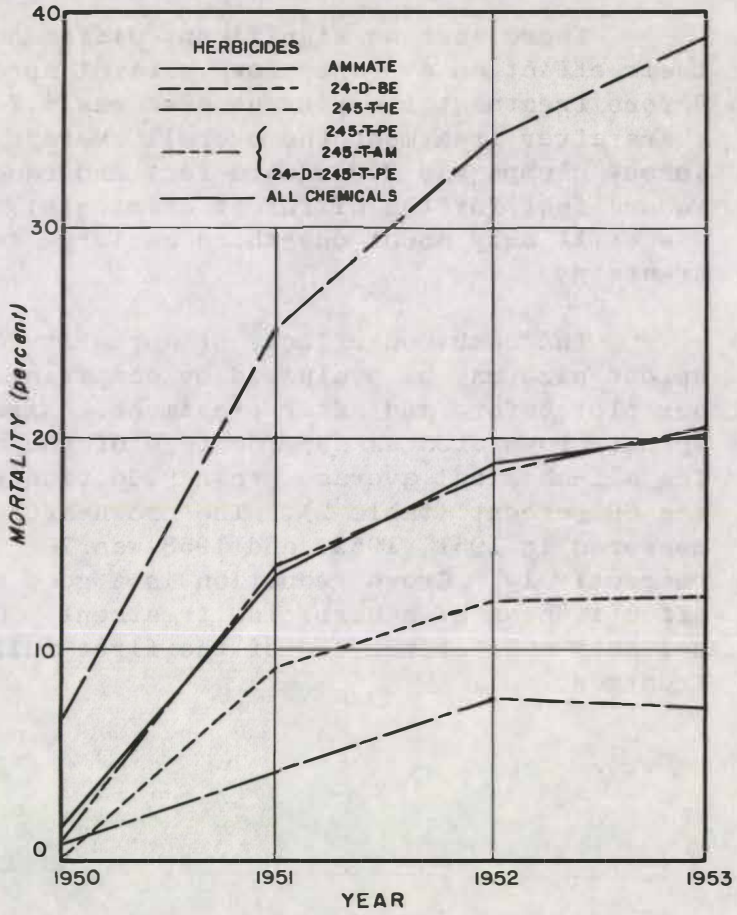
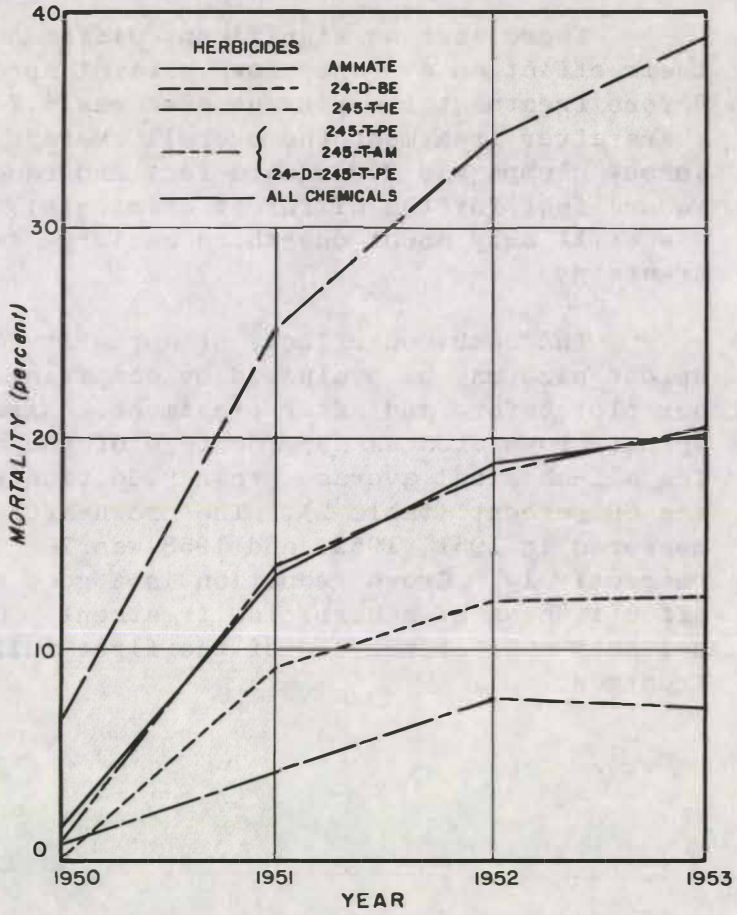


Figure 3.--Effects of different herbicides (all concentrations) on the mortality of blackjack oak and post oak by year.

The effectiveness of the chemicals varied. Some killed only a portion of the top, some killed the tops and roots. New sprouts developed at the base or on the stems of clumps that were not killed. The height of the surviving clumps averaged about 1.3 feet in September 1951. Height increased only slightly in 1952 and 1953.

The differences in height of sprouts in 1953 among trees treated with the various herbicides were small. The average sprout height in 1953 (all concentrations combined) for clumps sprayed with ammate was 1.2 feet, while sprouts sprayed with the other herbicides averaged about 1.5 feet. The height of living sprout clumps 3 years after treatment was about one-half the pre-treatment height.



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There were no significant differences among chemicals in their effect on average crown area of sprout clumps in 1953. Before treatment the average area was 6.7 square feet. Three years after treatment the overall average area of the surviving sprout clumps was 2.2 square feet and ranged from 2.0 to 2.3 square feet for the different chemicals. Thus the average area was still only about one-third as large as it was before treatment.

The combined effects of mortality and the reduction of sprout size may be evaluated by comparing the total crown area per plot before and after treatment. Expressing reduction in sprout crown area as a percentage of the original crown area, the all-chemical average crown reduction per plot by June 1953 was 69 percent (table 2). The crown-area reduction per plot as measured in 1951, 1952, and 1953 was 70, 70, and 69 percent, respectively. Crown reduction is a good measure of the temporary effectiveness of a herbicide treatment. Such an estimate may be reliably made at the end of the first full growing season after treatment.

Table 2.--Percent reduction in area occupied by crowns of sprouts treated in June 1950

Herbicide	Year		
	1951	1952	1953
Ammate	77	81	80
2,4-D-BE	66	66	64
2,4,5-T-IE	69	67	64
2,4,5-T-PE	70	70	68
2,4,5-T-AM	69	68	68
2,4-D - 2,4,5-T-PE	69	71	69
Mean	70	70	69

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Mean	70	70	69

Effectiveness Increased with Concentration

In general, mortality increased with increased concentration of herbicide (fig. 4). However, the effects of concentration on mortality varied somewhat among chemicals (table 1). Kills obtained with ammate and the 2,4-D - 2,4,5-T mixture increased consistently with concentration. In all other 2,4-D and 2,4,5-T compounds the relationship between concentration and mortality was erratic. By 1953, mortality for all chemicals combined was 16, 20, and 25 percent for the low, medium, and high concentrations, respectively. Because of the inconsistencies among chemicals, the overall effects of concentration were not statistically significant.

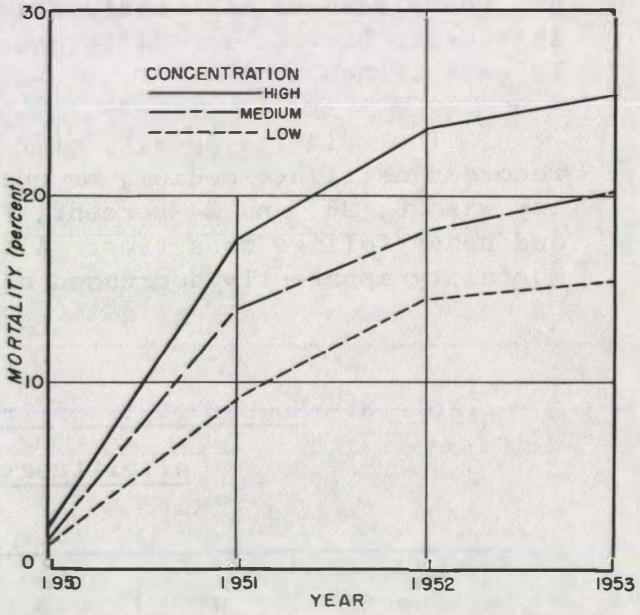

Figure 4.--Effects of different concentrations (all herbicides) on the average mortality of blackjack oak and post oak by dates of observation.

Increased concentration brought about a small but not significant reduction in sprout height. Differences among concentrations in the average crown area of individual sprout clumps were small. Sprout clumps sprayed with medium and high concentrations (all chemicals combined) had smaller average crown areas in 1953 (2.1 square feet) than those sprayed with the low concentration (2.3 square feet). These differences were statistically significant at the 5 percent level. The percent reduction in sprout crown area per plot (mortality plus reduction in average crown area) increased directly with concentration but differences were small and in no wise proportional to the increased quantities of herbicide.

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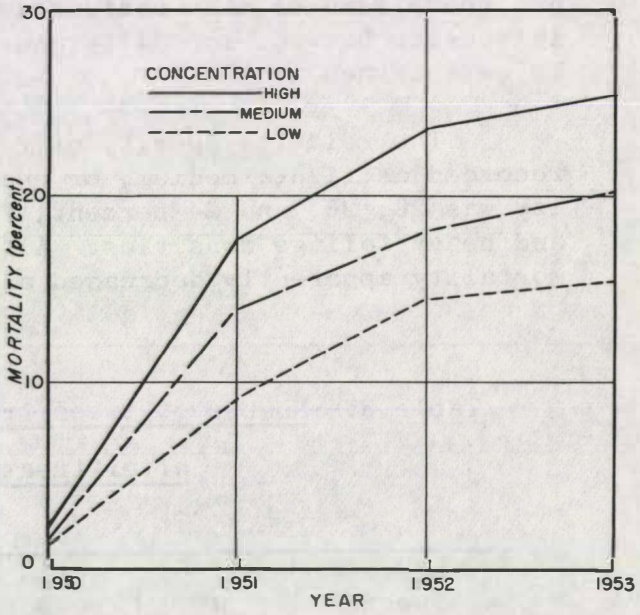

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Effects of Other Factors Studied

There were no differences in mortality, sprout height, or sprout clump area between blackjack and post oaks as determined by analysis of the 3-year data. However, for all chemicals and all concentrations combined, mortality by June 1953 ranged from 20 percent for blackjack and post oak to 46 percent for hickory (table 3).

Time of treatment--early morning, mid-day, or late afternoon--had no evident effect on sprout mortality or sprout size.

Mortality of sprout clumps decreased slightly with increased overstory competition. However, the apparent effect was so small and there were so many confounding influences that the true relationship between mortality and overstory competition could not be established.

The relative density of foliage for each sprout clump was recorded as light, medium, or heavy when the study began. Mortality was 28, 26, and 24 percent, respectively, for the light, medium, and heavy foliage densities. Although these differences were small, mortality apparently decreased as foliage density increased.

Table 3.--Number of trees treated and mortality 3 years after treatment by species

Species	Trees treated	Mortality
	Number	Percent
Blackjack oak	1,216	20.4
Post oak	825	20.4
White oak	369	28.5
Black oak	280	31.1
Hickory	98	45.9

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Summary and Conclusions

In June 1950, ammate and five different formulations of 2,4-D and 2,4,5-T were applied in water at three concentrations to the foliage of 6-year-old mixed-hardwood sprouts growing under a moderate hardwood overstory on a dry ridge site in south-central Missouri. The effects of the herbicides were evaluated in terms of mortality, sprout height, and crown area. Final observations were made in June 1953.

Mortality varied for the different species treated. The 3-year mortality was least for blackjack oak and post oak, which were equal, and greatest for hickory.

Mortality 3 years after treatment ranged from 8 percent for 2,4,5-T-IE to 39 percent for ammate when all three concentrations were combined for blackjack and post oaks. Mortality for all other herbicides was about 20 percent except for 2,4-D-BE which had 13 percent mortality.

There was little difference in the height of sprouts after 3 years except that sprout clumps treated with ammate had the shortest sprouts. The average area of sprout clumps at the close of the study did not differ greatly among clumps treated by the various chemicals. But the reduction of crown area of sprouts on the plots was greatest for plots sprayed with ammate.

Mortality increased as concentration increased but the differences among the three concentrations were small. Likewise, sprout height and crown-area reduction were not affected greatly by concentration.

Time of treatment (time of day) had no effect on mortality or sprout size.

The effect of the density of foliage on sprout clumps before treatment on mortality was very slight. Sprout clumps made up of many stems were more difficult to kill than sprouts with 1 or 2 stems.

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